Grade 4 — Mathematics Question 5

The academic expectations addressed by this item include:

1.5 -1.9 Students use mathematical ideas and procedures to communicate, reason, and solve problems.

2.13 Students understand and appropriately use statistics and probability.

The core content assessed by this item includes
  Probability/Statistics and Concepts
    • Students should understand average (mean), median (middle value of a set of data), mode (largest category in a set of data), range (difference in largest and smallest data value); the process of using data to answer questions (e.g. pose a question, plan, collect data, organize and display data, interpret data to answer questions).
 Skills
    • Students should be able to: construct and interpret displays of data (e.g., line graph, bar graph, pictograph), make inferences and draw inclusions based on data.
  Relationships
    • Students should understand the following relationships: how predictions can be based on data; and how the type of display is related to data.

5. **Bags of Candies**

The fourth-graders in Ms. Chung's class brought some candies that come in small bags. Each student in the class reported how many candies were in his or her bag. Here are the numbers the students reported.

16 19 17 18 18 20 23 15 17 16 17

17 18 19 19 21 19 18 21 17 21
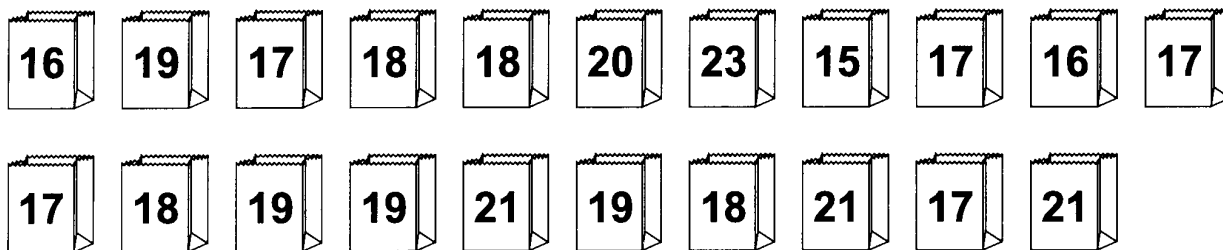
a. Make a graph, a table, or an organized list that shows the data above. Use the grid in your Student Response Booklet if needed.

b. Ms. Chung also bought a small bag of candies from the same place. Based on the numbers of candies in the students' bags, how many candies do you think are in her bag? Explain why you think that.

SCORING GUIDE

Score	Description
4	Part a: numbers organized in a clear graph, table or organized list. Part b: reasonable responses base on data from Part a.
3	Part a: numbers organized in a clear graph, table or organized list. Part b: meaningful response not based on appropriate data analysis; OR Part a: numbers organized in understandable graph, table, or organized list. Errors are minor. Part b: reasonable response based on data.
2	Attempt at graph, table, or organized list with errors, but using appropriate strategy, OR Reasonable response to Part b based on data.
1	Response shows minimal understanding.
0	Response incorrect or irrelevant.
Blank	Blank/no response.

Number of candies - frequency:

15-1	17-5	19-4	21-3
16-2	18-4	20-1	23-1

Examples of reasonable responses to part b:

- 17 because there were more bags with 17 candies
- 18 because there were lots of bags with 17, 18 and 19 candies.

Example of response not based on appropriate data analysis:

- 23 because Ms. Chung is bigger than the students.

Sample 4-Point Response of Student Work

Student organizes the bags by content quantity prior to constructing a prediction based on the data.

Student creates an accurate and clearly organized list of data.

Bags of Candy	No. in Bag
A) 1	15
2	16
5	17
4	18
4	19
1	20
3	21
1	23

B)   I think there will be 17 pieces of candy in her bag. There were more seventeen's than any other.

Student makes a reasonable prediction and supports the prediction by describing the mode as the basis for prediction.

Student chooses mode over the median or the mean as an appropriate basis for the prediction.

Sample 3-Point Response of Student Work

Table is organized but contains two minor errors: the bag containing 15 candies is omitted and the number of bags containing 21 candies is miscounted.

16's	17's	18's	19's	20's	21's	22's	23's
2	5	4	4	1	2	0	1

GRAPH

I think that Mrs. Chung got 17 pieces of candy because it was got the most.

Student makes a reasonable prediction based on the data.

Sample 2-Point Response of Student Work

I think Ms. Chung's bag of candy could have gotten 17 pieces of candy in her bag because more people got 17 than any other number. So most likely she got 17 pieces.
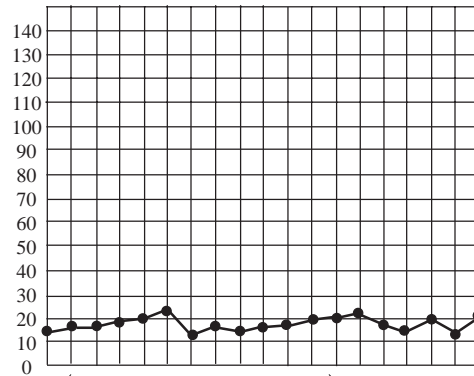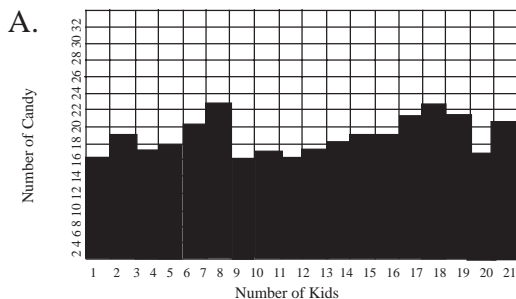
Student makes a reasonable prediction and supports the prediction based on the data.

Student does not organize the data prior to graphing.

Inappropriate graph, does not match the type of data.

Sample 1-Point Response of Student Work

Graph shows minimal skills of displaying and organizing data.

A.

Number of Candy

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Number of Kids

B. I think the teacher will get about 19 pieces of candy in her bag because it is between 16 and 23 and those are the highest and the lowest pieces of candy found in a bag.

Student shows some grasp of understanding of central tendencies, but makes a prediction that is not well supported by data.

INSTRUCTIONAL STRATEGIES

Bags of Candies

Include classroom experiences taking real data and organizing it in mathematically appropriate ways. Students design graphs, tables, organized lists and compare and critique each other's displays, discuss inappropriate displays. Experiences include actual collection of data in addition to given data. Daily newspapers are one source of given data. Teachers need to sometimes provide students with "fun" data to display and interpret.

Model and lead discussions on interpretations, implications and predictions based on data analysis. Data can be found in graphs, tables, and organized lists.

Use KIRIS-like open response questions in classroom instruction and assessment. Model strategies for explaining work to fellow mathematicians. Model and have students develop and use scoring guides with open response items. Encourage students to explore highlighting and underlining strategies as organizers, stressing that only evidence found in Student Response Book is scored on KIRIS open responses.

Infuse lessons with the use of a variety of instructional approaches and strategies:
- use mathematical tools, manipulatives, hands on activities, cooperative group work, higher order thinking skills, video tapes, multiple intelligence approaches, mappings, graphic organizers, etc.

Explore appropriate use of calculators, both as tools and instruments for checking work.

REFERENCES

TRANSFORMATIONS Kentucky's Curriculum Framework
    Academic Expectations 1.5-1.9 and 2.7 through 2.13
KDE's Core Content for Assessment
    Mathematics, examine curriculum alignment from P through 12
KDE's web site at http://www.kde.state.ky.us
Curriculum and Evaluation Standards for School Mathematics,
    Professional Standards for Teaching Mathematics, Assessment
    Standards for School Mathematics, and Addenda Series from NCTM.
    Telephone: 703-620-9840, web site at http://www.nctm.org
KDE's Primary Performance Tasks
    Telephone: 800-547-4999, KIRIS Service Center